volumes. A present-day book for beginners should contain little more than the basal principles and the more striking and interesting facts and illustrations. For advanced work special treatises on separate branches of the science are desirable. Already the economic or industrial geology has been divorced from general study. The same is true for earth forms or physiography; and partially for paleontology. Further differentiation may cover dynamics and geophysics; surficial processes; sedimentation and structure; meteorologic and glacial geology; with perhaps later division of the historical.

Grabau is now in China, as professor of paleontology in the University of Peking, and Paleontologist to the Chinese Geological Survey, and we may anticipate further enrichment of geologic literature from his prolific and facile pen.

H. L. FAIRCHILD

SPECIAL ARTICLES

A PRECISION DETERMINATION OF THE DIMENSIONS OF THE UNIT CRYSTAL OF ROCK SALT

ALL measurements of X-ray wave-lengths and of crystal structures depend upon the solution of the atomic marshalling of some crystal and a calculation of the dimensions of the fundamental unit of that crystal in terms of its mass and density. The crystal most used in this connection is rock salt (NaCl). It is the purpose of this note to give the side of the unit cube of NaCl in terms of the most accurate data available.

The NaCl crystal was early shown by Bragg to be a cube, alternate corners of which are occupied by Na, the remaining corners being occupied by Cl. Since one half of one Na and one half of one Cl are each associated with one unit cube, the mass of the unit must be

$$1/2\,[A_{\mathrm{Na}} + A_{\mathrm{Cl}}]\,m,$$

where A_{Na} is the atomic weight of Na,
A_{Cl} is the atomic weight of Cl,
m is the mass in grams associated with one unit of atomic weight.

The 1919 International Table of Atomic Weights gives

$$A_{\mathrm{Na}} = 23.00$$
$$A_{\mathrm{Cl}} = 35.46$$

If these values should be wrong by .01 the error would be less than .05 per cent. in each case.

m is most easily found as e/F where e is the charge on the electron, F is the Faraday constant in electrolysis. Millikan[1] gives e as 4.774×10^{-10} Abs. E. S. units of charge with a maximum error of .1 per cent.

This gives $e = \log^{-1} \overline{1}9.20176$
$= 1.591 \times 10^{-19}$ absolute coulombs.

Vinal and Bates,[2] of the Bureau of Standards give

F (Iodine) $= 96{,}515$
(Silver) $= 96{,}494$

Mean $= 96{,}505$ international coulombs.

They have determined the absolute coulomb as being .004 per cent. greater than the international coulomb, and recommend the value in absolute coulombs,

$$F = 96{,}500$$

The maximum error is .01 per cent.

From the above

$$m = e/F = \log^{-1} \overline{2}4.21723$$
$$= 1.649 \times 10^{-24}\ \text{gms.}$$

The density of NaCl is given by Zehnder (1886) as 2.188, by Retgers (1890) as 1.167, by Krickmeyer (1896) as 2.174 and by Gossner (1904) as 2.173. Gossner's work[3] seems to have been done with special care. He measured eleven artificial crystals of NaCl, obtaining densities ranging from 2.171 to 2.175. His measurements on natural crystals gave 2.173. Taking these results in connection with those of Krickmeyer, we may assign to NaCl a density of $2.173 \pm .002$, thus giving a maximum

[1] R. A. Millikan, "A new determination of *E*, *N*, and related constants," *Phil. Mag.*, *34*, 1917.

[2] G. W. Vinal and S. J. Bates, "Comparison of the silver and iodine voltameters, and the determination of the value of the Faraday," *Bull. Bureau of Standards*, *10*, 425, 1914.

[3] B. Gossner, "Untersuchung polymorpher Körper," *Zeit. f. Kryst.*, *38*, 132, 1904

error of .1 per cent. It should be understood that this density refers to measurements at room temperature. The coefficient of expansion of NaCl is given by the Smithsonian Tables as $.40 \times 10^{-4}$, so that a variation of 10° C. in either direction from normal room temperature would make an error of less than .05 per cent. in the side of the cube.

The volume of the unit cube of NaCl is therefore

$$V = \frac{\text{Mass}}{\text{Density}} = \log^{-1} \overline{23}.34600$$
$$= 22.182 \times 10^{-24} \text{ cc.}$$

and the side of the unit cube is

$$d = \log^{-1} \bar{8}.44867$$
$$= 2.810 \times 10^{-8} \text{ cm.}$$

Even if all the values entering into this result were in error to the maximum amount, and all in such a direction as to affect the final result in the same sense, the change in the value of d would be less than .1 per cent.

For purposes of reference, the table below gives the logarithms of the interplanar distances of a simple cube of side $\log^{-1}$ .44867 and the actual distances to three decimal places. These lines are all found in the powder diffraction pattern of NaCl. The additional lines of the face-centered cube of Cl ions ($d = 5.620$) are not included in the table as they are too faint to measure easily on a film and are therefore useless for calibration purposes.

Plane	Log Distance	Distance
100	.44867	2.810
110	.29816	1.987
111	.21011	1.622
100 (2)	.14764	1.405
210	.09919	1.257
211	.05960	1.147
110 (2)	$\bar{1}.99713$	.993
211 / 100 (3)	$\bar{1}.97115$	.936
310	1.94867	.889
311	$\bar{1}.92798$	.847
111 (2)	$\bar{1}.90908$	.811
320	$\bar{1}.89170$	.779
321	$\bar{1}.87561$	.751
100 (4)	1.84661	.702
410 / 322	$\bar{1}.83345$	.681
411 / 110 (3)	$\bar{1}.82104$	.662
331	$\bar{1}.80930$	.645
210 (2)	$\bar{1}.79816$	.628
421	$\bar{1}.78756$	.613
332	$\bar{1}.77746$	.599
211 (2)	$\bar{1}.75857$	.574
430 / 100 (5)	$\bar{1}.74970$	.562

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THE AMERICAN ELECTROCHEMICAL SOCIETY

SOCIAL EVENTS, LECTURES

It was generally conceded by all in attendance at Lake Placid that a most unique meeting place had been selected for a Fall meeting. Through the courtesy of the Lake Placid Club their recreation facilities were placed at the disposal of our members and afforded excellent opportunities for taking part in golf, tennis, motoring and mountain hiking.

A great deal of the success of the meeting is due to Mr. W. M. Corse, who spared no effort as acting chairman of the arrangements committee.

On Thursday, September 29, at 9 A.M., the fortieth General Meeting of the Society was called to order by President Acheson Smith, who then introduced Dr. Melvil Dewey, founder and president of the Lake Placid Club. Dr. Dewey cordially welcomed our members and mentioned several points of interest that everyone should see while at Lake Placid. The reading and active discussion of papers followed this talk and were continued in the mornings of the next two days, the features of which were respectively the symposiums on Non-ferrous Metallurgy and Electrodeposition.

The boat ride, on Thursday afternoon, comprising a round trip on Lake Placid, was enjoyed by each of the 48 persons on board.

A brief history of the Lake Placid Club was outlined by Dr. Dewey in a short talk preceding the lecture on "Chemistry and the Stars" by Professor Harlow Shapley. With the aid of lantern slides Professor Shapley presented a very interesting account of the stellar universe and of the work being done at the Mt. Wilson Observatory.

Friday afternoon. A mountain hike up Mt. MacIntyre was a thrilling experience for all in the party. The club lodge at the base of this peak was reached by motor car through 10 miles of winding roads. An unusual rain storm prevailed before the party had reached the halfway mark, but this was